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ABSTRACT

Alberta recently mandated an ICT (information and communications technology) Program of Studies that requires the infusion of digital technologies into core curricula and across all grades. Effective implementation of ICT demands that all teachers create inquiry-based, technology enabled learning environments for children. The design of digital and media rich learning experiences calls for a dramatic shift in teacher preparation. Student teachers must routinely encounter the effective infusion of technology in all aspects of on-campus learning as well as in classroom placements in schools. This paper describes the design, implementation and evaluation of an undergraduate seminar offered to student teachers in the fourth semester of a two-year degree program at the University of Calgary. Outlined are ways in which fundamental issues in technology integration were addressed, how successes were achieved, and how discoveries from the first two seminars direct on-going modifications. (Contains 17 references.)
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New Ways of Preparing Teachers for Technology Integration

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ABSTRACT: Alberta recently mandated an ICT Program of Studies that requires the infusion of digital technologies into core curricula and across all grades. Effective implementation of ICT demands that all teachers create inquiry-based, technology enabled learning environments for children. The design of digital and media rich learning experiences calls for a dramatic shift in teacher preparation. Student teachers must routinely encounter the effective infusion of technology in all aspects of on-campus learning as well as in classroom placements in schools. This paper describes the design, implementation and evaluation of an undergraduate seminar offered to student teachers in the fourth semester of a two-year degree program at the University of Calgary. Outlined are ways in which fundamental issues in technology integration were addressed, how successes were achieved, and how discoveries from the first two seminars direct on-going modifications.

In September 2000, teachers in Alberta, Canada began a three-year implementation process for an ICT Program of Studies (Alberta Learning, 2000). This innovative curriculum, demanding the effective infusion of technology for communicating, inquiring, problem-solving and decision-making in core curricula, raises important questions about what it means for students to think and learn with the full range of digital technologies that are so much a part of today's changed—and changing—world.

Educational technology research (Clifford & Friesen, 2001a; diSessa, 2000; Goldman-Segall, 1998; Jacobsen & Goldman, 2001; Papert, 2000, 1980) and the experience of the Galileo Educational Network (<http://www.galileo.org>) paint a similar picture of what thinking and learning need to look like in a knowledge era. We no longer live in a world in which information is scarce. The old certainties of a world defined by four classroom walls and impermeable boundaries have disappeared forever, replaced by global interdependencies and complex systems that require flexibility, responsiveness, and imagination. Overwhelmed by information from a wealth of sources, students desperately need the skills to create new knowledge, not just consume the old. Problems do not come neatly packaged, defined-in-advance, and amenable to the rote application of familiar strategies.

Our society can no longer afford to think of engaged learning, nimbleness, creativity and commitment to action as educational embellishments to “the basics”. Multiple and conflicting perspectives are not problems to be fixed, ignored or eliminated; they are the way the world works. Our human survival depends on an ability to learn new things, imagine creative possibilities and design useful solutions in deeply ambiguous and confusing situations. It depends on our ability to teach our children how to do this, too. And thus, questions of how to prepare a new generation of teachers, many of whom have been schooled in old ways despite their relative youth, are increasingly pressing in their urgency.

NEW WAYS OF LEARNING DEMAND NEW WAYS OF TEACHING

Today's classrooms do not look much different than they did 20 years ago when schools began to invest heavily in technology. While recognizing that there are pockets of genuine innovation in classrooms, schools, and universities across North America, we feel confident in making a few generalizations about the current state of affairs. *First*, while many school and university students are using technology in their personal lives in a wide variety of ways, they are not using computers very extensively in classrooms in order to learn effectively in a variety of subject areas. The gap between presence and use of technology is particularly wide in high school (Cuban, Kirkpatrick & Peck, 2001). In fact, there is a growing “digital divide” between what students actually do with technology at home and what they are allowed to do in school. A growing number of students routinely expect their school computers to be out of date, connectivity to be slow, networks to be unstable, and their teachers' knowledge and confidence about technology to be significantly less than their own.

A *second* general trend is that many classroom teachers and faculty members in teacher preparation programs lack confidence in their own ability to think broadly with technology. Conventional models of professional development, like workshops and courses, have not been particularly successful in helping educators find ways to integrate technology for learning. Related to this second trend is our *third* observation that even education faculty and teachers who feel confident about their own ability to use computers for professional tasks often feel uncertain about how to use technology in their teaching. Almost by default, visions for the use of technology for teaching and learning are often created by IT specialists who are not educators. Network designs and levels of student access are often determined according to what is standard, easy to monitor and maintain, rather than according to what is educationally sound. Dominant curriculum models and assessment agendas tend to emphasize course delivery and information-transfer rather than knowledge creation and designing something new. While there are thousands of examples of digital media objects and teacher-created units and lessons that claim a meaningful technology component, there are far fewer authentic images of the effective and imaginative use of technology to create new learning experiences.

Teachers and leaders in the schools and school districts are looking to new teachers to shore up the gap between technology presence and use. However, our *fourth* observation is that the current generation of student teachers simply do not routinely infuse technology in their own learning and teaching, and thus, too few of them graduate with the skills and experiences that are needed to transform today's classrooms. People entering the profession today are as unlikely to have experienced technology-rich, constructivist learning environments as their more experienced colleagues in schools. There is a great deal of *talk* about constructivism on North American campuses, but very few actual examples either on campuses or in schools of how to live, learn and lead in these ways.

TEACHER PREPARATION AND TECHNOLOGY INTEGRATION

A shift in thinking is required for teacher preparation that is similar to that needed in professional development for classroom teachers (Clifford & Friesen, 2001b; Jacobsen, 2002, 2001). It is simply not good enough to teach the next generation of teachers in ways we were taught. Student teachers must routinely encounter the effective infusion of technology in the normal course of their learning at the university and in their practicum placements in schools. The three of us have co-taught students teachers about integrating technology into their learning and teaching for two years. Our planning for this special topics seminar on integrating technology across the curriculum was guided by our vision of engaged learning and educational reform (Clifford & Friesen, 2001b, 1998, 1993; Jacobsen, 2002, 2001), and our commitment to address the kinds of concerns that we outlined at the beginning of this paper. Our seminar was not *about* technology; it was about teaching and thinking *with* technology. Moving well beyond skills acquisition or a focus on software applications, we instead created a *context of use* within which student teachers learned by designing learning opportunities for real children in real classrooms.

Opportunities were created for student teachers to learn in just the ways they will be called upon to teach children (Clifford, Friesen & Jacobsen 1998). We drew on what we know about good professional development practice: (1) technology is best learned just-in-time, instead of just-in-case, (2) planning, designing, implementing and evaluating are best done in collaboration with others, (3) learning must be situated in authentic, challenging and multidisciplinary tasks, (4) a culture of inquiry around technology for learning supports risk-taking and knowledge creation, and (5) teachers need intentional and meaningful opportunities to reflect on professional development and growth.

Technology Is Best Learned Just-In-Time, Not Just-In-Case

In our seminar, student teachers took advantage of new technology-enabled learning spaces in the Faculty of Education. Our learning environment leveraged the ubiquitous and unfettered access to technology in the seminar space (i.e., 16 networked workstations) and also in the larger public learning spaces (i.e., additional workstations, multimedia development suites, scanners, digital cameras, CD burners, and so on). The fluid access to technology tools, Internet access and to each other enabled students to gather around a workstation or deskspace to collaborate, and to move out into public spaces as needed. The permeable environment permitted flexible arrangements and grouping, and also provided ready access to other experts (i.e., Faculty support staff). Technology skill was developed in the context of developing a web-based portfolio, completing a group-selected focused technology task, constructing an integrated, multidisciplinary unit of studies, and carrying out an independent inquiry project in the field.

"Oh, easy for Leonardo"

Our first task seemed simple enough; students were required to engage with the program of studies, and publish a reflective response on a web site they themselves had to design and maintain. Predictably, it sent many into a tailspin (not unlike that experienced by seasoned classroom teachers and faculty members when they attempt a new technology project). Some students cried, a few complained, and many were worried about a perceived mismatch between their present ability and our expectations. Some students had created web pages before, and set to designing their web site at once. Others worked with us to learn how use the template and how to upload their finished sites to the university server. Each time a new site went up, there were whoops and squeals and broad grins of pure delight. Students felt the special rush of seeing their own work on the web. They were like parents with a newborn – even though some of the initial sites were a little plain and a bit wrinkled, they were beautiful to their creators.

Several of our students talked about "being inspired into a culture of use" which is different in kind than the application focus of many preservice teacher courses on computers. The pervasive assumption of most courses available to student teachers is that everyone needs to learn the same technology skills at the same time before they can do anything meaningful with them. Different assumptions permit new possibilities to emerge. We concentrated on just-in-time, not just-in-case, instruction with technology applications. We introduced meaningful, challenging and multidisciplinary tasks that posed complex and meaningful learning problems, and that enabled a host of possible solutions. In the context of these tasks, the three of us coached and guided individuals and groups of students to design creative solutions, and to acquire the skills and competencies they needed to solve their problem in the way they wanted to approach the task, and respected their individual starting points and needs.

Collaborative Planning, Design, Implementation And Evaluation

All of our approaches to using and learning technology in the seminar were in service of actual design tasks, not in service of learning technology for its own sake. We put student teachers in the position of the children they are going to teach. In collaborative groups, students completed one of eleven tasks initially designed for kindergarten to grade eleven students. The tasks required little prior experience with technology in order to get started. However, because of the nature of the tasks, there was no upper limit on the sophistication of technology use that was possible. Thus, there were steep learning curves for all students no matter what their starting point. Everybody got to sweat the same, all students experienced the value and necessity of working in teams to build on the strengths and diversity in the group, and everyone began with the experience of actually designing and constructing a solution to an interesting problem.

Situating Learning In Authentic, Challenging And Multidisciplinary Tasks

Planning for engaged student learning (NCREL, 2000) and technology integration requires an applied understanding of project, instructional and task design. To move beyond the "add on" approach of using PowerPoint™ or word processing as ends in themselves, teachers need to think and plan carefully about how to infuse technology in teaching and learning. Working in small groups, students collaborated on the design and development of an Integrated Unit of Study for authentic and meaningful integration of technology into one or more core curricular area.

A major requirement of the fourth semester in the University of Calgary program is that students engage in an independent inquiry project that is curriculum and practice oriented. Ideally, these are field-oriented projects at a school or Community Work Place site that enable student teachers to work side-by-side with classroom teachers and students to study essential questions to do with teaching practice. Students engage in critical inquiry in a systematic and intentional manner, contribute to ongoing efforts to improve teaching and learning at the field site, and demonstrate the understandings and skills acquired throughout the first three semesters of the Master of Teaching program. There is an expectation that the students' work will leave a legacy in the field. Inquiry projects were designed to immerse student teachers in challenging and multidisciplinary work that made a difference in the present. One of our students, Heather, learned how to construct and program Lego® robots alongside grade one and two students and their teachers in an elementary school. As the opportunity to work with robotics progressed through each grade, Heather became part of the coaching team, working with teachers and students right up to grade five. As her own expertise grew, the school came to depend on Heather's contribution, her insights and her creative solutions. She focused her inquiry project on documenting and interpreting her experiences with young children and robotics. The result of the inquiry project is not simply a research report; instead, the inquiry process fosters closer connections between campus and field experiences, observations and learning.

Creating A Culture Of Inquiry Around Technology For Learning

One of the most powerful aspects of our special topics seminar was the intentional placement of students in enriched field settings for their inquiry projects. About one third of the class worked in schools in which the Galileo Educational Network provided on-site support to teachers to design new learning experiences via effective technology infusion. In most teacher preparation programs, field placements are more generic: students are matched to schools and partner teachers according to grade and subject specialty. This approach to field placements builds on the notion that the main goal is to make sure the numbers work given certain broad category matches. It assumes that, in essence, schools and classrooms are convenient places for student teachers to "practice". Teacher associations, that vehemently argue that all teachers are equally excellent in exactly the same way, present an obstacle; to them, targeted placements smack of elitism. Our experience counters this view; we did not target "good" or "better" schools and teachers. Instead, we asked ourselves: what energies can we leverage by placing student teachers committed to developing their ability to infuse technology into classrooms with experienced teachers who are also intentionally pursuing their own professional growth in this area? Given a four-month semester, we knew that we could maximize the impact of students' on-campus work by placing them in field placements where the infusion of technology was also a priority.

Reflection On Professional Development And Growth

All certified Alberta teachers are required to complete an annual professional growth plan that includes goals, strategies and evaluation. Teachers are expected to consider the Teacher Quality Standard (Alberta Learning, 1996), the school division's goals and plans, and their own school's improvement plan when developing professional growth plans. While plans of such detail were not appropriate in a special topics seminar, we did reinforce the experience of our students throughout the whole MT program: the importance of cultivating reflective and thoughtful habits of mind about professional practice. To that end, our students prepared a professional growth plan throughout the seminar that included three self-assessments that were published as part of a web-based, electronic portfolio.

WHY DID THIS SEMINAR WORK?

The most significant indicator that our seminar was successful is the high caliber of the students' scholarship. The quality of their work, their thinking and their reflection was exemplary. Each student was able to meet seminar requirements for curriculum design, for planning and carrying out substantive inquiry, for reflection on professional growth, and for the acquisition of technology skills. We prepared a CD ROM of all the units of study that students created, and the focused tasks on which they had worked. From our perspectives both in staff development and in graduate level teaching, we have no hesitation in saying that each of our students left the class better prepared to infuse technology in their own classrooms than many experienced teachers. Many tackled inquiry projects at a level of complexity that approached performance expectations for graduate work. It was hard work. For most, there was a huge learning curve, coupled with a determination to dig in and learn what was needed in service of important ideas. That is, the culture of inquiry we talked about creating in classrooms became a living part of the seminar, itself.

Building on Diversity - We believe the exceptional degree of student success and engagement was an outcome of deliberate design and instructional decisions that were informed by our knowledge of the current state of affairs in schools and on campus. First, the space in the seminar was open enough for all students to define a place for themselves. We designed the seminar so that it required a wide range and diversity of experience, ideas and projects. From the first day, our students learned that it did not matter what grade or subject they were preparing to teach. We were not concerned whether they had extensive experience with technology or none at all. It was all right to prefer different platforms, different software, and alternative approaches to tasks than the ones we suggested. That is, we structured exactly the situation we wanted tomorrow's teachers to create for their own students. Students came to see that diversity was not a problem to be overcome, but an essential resource on which we all can draw when asked to complete complex and demanding tasks together.

Insisting on a Pedagogical Focus - Second, all aspects of the seminar were centered on pedagogical issues rather than technology issues. There are two apparently contradictory consequences of a strong initial focus on technology skills acquisition in the common kinds of workshops and courses designed for those who are new to technology. The *first* consequence is that participants often seize on one or two of the applications they first learn to use, assuming that now

the job of covering technology is taken care of. This enthusiasm is apparent in how often teachers introduced to planning a technology enriched experience for students start with statements like this, "I was thinking of letting kids do Power Point™ reports on an animal they choose..." Jamie McKenzie (2000) uses the felicitous phrase "power pointlessness" to describe the careless adoption of an otherwise effective presentation tool as if it were the be-all and end-all of technology use in the classroom. The *second* consequence of an initial focus on skills acquisition is that such a focus feeds the growing sense of panic that sets in when many of us squarely face a harsh, but often unspoken reality about technology: no mere mortal can keep up with the innovations. No one in a classroom is going to win the race against new hardware, new applications, and new capabilities. There is always a new version, a new digital device or a new idea coming down the pipe. Considering the range of applications now available to students and teachers, and the rate at which new versions are introduced, it is easy to feel overwhelmed even by finding a starting place.

When student teachers can be convinced to give up the idea that they need to know *this* application, and *this* application, and *this* application, and accept that they will never know everything about every piece of software, they undergo a transformation. Many suddenly feel liberated. They feel a burden lifted when we say to them, "Look, there is no way you will ever be faster, more fluent, or more knowledgeable about the technology that is out there than all of your students. And you know what—that's okay. It actually gives you a whole lot more room to get important things happening. There are some things that the kids will always do better than you. Let them. And there are important things that they need to be taught. *Your job as a teacher is to design rich and meaningful learning experiences.* They don't know how to do that. You have to figure out what these applications are good for. The kids will figure out how to drive them."

It is often the ideas that accompany technology integration that intimidate teachers and university faculty alike. Teachers sometimes ask us, "If I start letting the kids use all this technology, what's happened to my role as a teacher?" Of course, what they are really asking is what will happen to *me*? Do I still have anything of value to offer? Confident technology users ourselves, we know that deep understandings of the character of inquiry-based learning and knowledge construction have never been more important than they are in digitally rich environments (Clifford & Friesen, 2001a; Jacobsen & Goldman, 2001). It is entirely possible to do foolish things with powerful tools just because they are there. Our challenge was to help our student teachers develop fluency with *teaching and learning with technology*, not just with technology, itself. A critical awareness of issues to do with technology integration was revealed when one of our students wrote to us about her reaction to the ICT program of studies and our talk about teaching and learning as the primary focus of the seminar. "I thought", she told us, "that only people who were *against* technology ever raised questions about ethics and values and what is worth doing. I was amazed to find it in the ICT program of studies, and to hear the three of you say critical things, too".

Team Teaching – The three of us worked collaboratively with one another and with the support staff who were available to assist our students. The seminar was enacted through the genuine collaboration and diverse range of skills that are required to get complex things done. We depended on our own collaborative efforts, and we valued and encouraged opportunities for students to access one another's expertise. This collaboration extended to the field placements, and the students contributed to and benefited from the diversity among teaching staff as well. In a world in which we know we must prepare students to work effectively in teams both to define and to solve problems in ambiguous situations, teacher isolation is a terrible problem. The culture of schooling makes it very difficult for teachers to form strong work teams. As part of helping student teachers both experience and understand the power of collegial support, we required students to become interdependent. There was no way that any student could meet the demands of this seminar alone. They needed each other, they sought out one another, and they had to negotiate all the ordinary troubles of working together as part of their learning.

CONCLUSIONS

A deep commitment to the principles that pervade the entire teacher preparation program at the University of Calgary guided the creation of our special topics learning environment. We opened spaces in which student teachers used ICT fluently for personal productivity in the creation and maintenance of scholarly work. Student teachers developed an understanding of Alberta Learning's (2000) ICT Program of Studies, and discussed implications for learning and teaching in their discipline/grade level and for their own professional growth plans. Students were articulate in describing the ways that technology had influenced their own learning and in describing the ways they had seen

technology play a role in others' teaching and learning. In groups, and as individuals, students wrote, communicated, made decisions, and conducted inquiry smoothly and effectively using technological aids if and when these digital tools contributed to those processes. Students intelligently questioned uses of ICT and were appropriately skeptical about naive enthusiasms and overly simple solutions. In the context of focused tasks and integrated units of study that they designed and created, students discussed the strengths and weaknesses of ICT in a wide range of applications.

In the course of this special topics seminar, students moved beyond being mere proponents of ICT usage, or already-hardened skeptics, and developed further as thoughtful professionals who choose and design tools appropriate for the tasks they needed to accomplish. Students developed an informed personal position on technology integration in education and articulated and defended that position with each other. In the school placements, student teachers encouraged children both to actively question the place of ICT in their learning and to make responsible use of ICT in their own work. In the context of their own creative work, student teachers understood and developed ethical dispositions and practices in relation to the uses of technology in the classroom. Finally, our student teachers developed a capacity for critical inquiry in the applications of technology in learning and teaching, an essential disposition given the rapid pace at which information technologies are transforming our world.

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